nature of the excisions, transpositions, and other devices by which the Roman forger set to work to eliminate from the manuscript all trace of Galileo's having been, as Scartazzini stoutly maintains that he was, submitted to the actual torture. S. T.

THE AGRICULTURAL SOCIETY

The Journal of the Royal Agricultural Society of England. Part II., 1877.

THE current number of the Royal Agricultural Society's *Journal* is chiefly occupied with reports of the agricultural exhibitions held during the present summer at Liverpool and at Hamburg, and with reports on farms in Lancashire, Cheshire, and North Wales, which obtained the Society's prizes for good management at the Liverpool meeting. Another report deals with prize farms in Ireland in connection with the competition for small farms instituted by Earl Spencer. Besides these we have two lengthy papers on the American export meat trade, by Prof. Sheldon, of Cirencester, and by Prof. Alvord, of Easthampton, Massachusetts; three papers on village clubs, by Sir E. C. Kerrison, and Mr. Lawes; a paper on the impurities of clover seed, by Mr. Carruthers; and a short report of some investigations on foot-and-mouth disease, conducted at the Brown Institution.

The international exhibition at Hamburg was one of considerable importance: it was devoted exclusively to dairy husbandry. Lying, as Hamburg does, in the immediate neighbourhood of the great dairy countries of Northern Europe, an excellent opportunity was afforded of noting the advance made in dairy work during the last few years. The great improvement which has signalised this period is undoubtedly the use of ice in cream-setting. This invention dates from 1864, and is the work of J. G. Swartz, a Swedish farmer. In the ordinary method of cream-setting the milk is placed in very shallow pans, and stands for thirty-six hours or more while the cream is rising. The milk during this time usually turns sour, and the cream becomes contaminated with free fatty acids, with partially decomposed albuminous bodies, and with other products injurious to the flavour or keeping qualities of the butter. In Swartz's plan the milk, as soon as it reaches the dairy, is placed in deep metal pails, standing in a vessel full of ice. Not only does the low temperature reduce the process of change to a minimum, but, quite unexpectedly, it also greatly facilitates the rising of the cream; so that in pails having sixteen inches' depth of milk the cream is nearly all obtained in twelve hours. The butter churned from this sweet cream is not only very pure in flavour, but has remarkable keeping qualities. This plan, which is rapidly spreading in the north of Europe, and in the United States, is at present scarcely known in England. One obstacle to the general use of the method is undoubtedly the difficulty of procuring a sufficient supply of ice in such a climate as ours. This difficulty has been greatly diminished by the investigations of Prof. Fjord, of Copenhagen. He has shown that snow, if collected after thawing has begun, may be easily trodden into as small a compass as ice, and may be used with equal economy. The collection of snow is also far less laborious than the carting of ice, as the snow may be gathered in the immediate neighbourhood of the homestead. Let us hope that English dairy farmers will not be slow to adopt the scientific methods of their continental brethren.

Statistics regarding the meat-producing capabilities of the United States and Canada are fully given by Profs. Sheldon and Alvord. The number of cattle in the United States is at present about 28,000,000, or three times as many as those in Great Britain and Ireland. The proportion of cattle to population is, in the United States and Canada, about 67 : 100; while in the British Isles the proportion is about 29 : 100. The total area of the farms in the United States is about $8\frac{1}{2}$ times that of the farmed land in the British Isles, while vast tracts of country yet remain to be cultivated. In 1875 the number of acres under Indian corn in the United States all but equalled the whole number of acres under cultivation in our own country.

With such enormous capabilities of production, the only condition wanting for a large export trade is a cheap and efficient means of transit. That such a mode of transit has now been established is proved by the quantities of meat already exported to England. We received in 1876, from New York and Philadelphia, 19,838,895 lbs. of fresh beef; and the trade has so rapidly extended, that in the first four months of 1877 the imports exceeded the whole import of the preceding year, and amounted to 22,812,128 lbs.

The means adopted to preserve so perishable an article as fresh meat during the long journey from America to England is artificial cold. The cattle are slaughtered at the port of embarkation. At the establishment in New York an ox is killed, and the skin and offal removed in the space of three minutes. The carcase is then cooled to 40° F. in a room through which a constant current of cold air is maintained from an ice chamber. After forty-eight hours the carcase is cut up, and placed in the refrigerators of the steamer, and thus conveyed to England. During the voyage a temperature of 37°—40° is maintained, a stream of dry cold air being circulated through the meat-chamber.

The source of cold has hitherto been ice, but a new cooling agent of great power and adaptability promises soon to supersede the use of ice. The invention is due to Messrs. Giffard and Berger, of Paris. In their process air is condensed by a steam-engine, the heat evolved on condensation being removed by a stream of cold water. The cool condensed air is then conveyed to the chamber which is to be refrigerated, on entering which it is allowed to expand again to atmospheric pressure. The cold thus produced is intense. The ease with which the cooling power can be conveyed to distant places, and the fact that ventilation, as well as cold, is accomplished, will probably procure numerous applications for this valuable invention.

For the extension and success of the American meat trade we now only require to erect suitable refrigerating stores, and to provide refrigerating railway-cars, for the safe conveyance and preservation of the carcase after it has reached our shores.

We have no space to refer in detail to the remaining articles. Those who feel an interest in the improvement of the agricultural labourer will find much suggestive matter in the papers on village clubs, while the kindred

subject of the improvement of peasant farmers is ably discussed in Prof. Baldwin's report on the Irish prize farms. R. W.

OUR BOOK SHELF

Oregon: its Resources, Climate, People, and Productions. By H. N. Moseley, F.R.S. (London: Stanford, 1878.)

THIS little manual is the result of a visit paid in July and August last by Mr. Moseley to Oregon. Mr. Moseley gives not only the results of his own observations, but has taken the trouble to consult carefully and give the gist of official publications on the state, the result being a thoroughly satisfactory, full, and trustworthy account of the present condition of Oregon. Mr. Moseley has done a public service in undertaking this task, and we recommend his book to all who contemplate emigrating. It will answer nearly every question an intending emigrant is likely to ask, and gives, moreover, very definite advice as to the kind of people for which the state at present is suited. The book contains an excellent map of the state.

A Handbook of Common Salt. By J. J. L. Ratton, M.D., M.C. Madras College. (Madras: Higginbotham and Co., 1877.)

THIS work is not to be judged as a scientific treatise, but as a practical guide to the manufacture of common salt from sea-water. The author has fulfilled the purpose which he set before himself in compiling the book. Starting with a brief historical introduction, he proceeds to lay before the reader a concise statement of the principal chemical and physical qualities of salt. The occurrence of salt as a mineral is then shortly discussed; the analysis of natural salt occupies a small chapter, which is succeeded by others upon the hygienic value of salt, and upon the agricultural uses of the same substance. The principal rock-salt deposits are described, and the mining operations sketched.

After these chapters, which must be considered as introductory, the composition of sea-water is discussed; the leading facts concerning evaporation of solutions of mixed salts, and fractional precipitation of the saline substances, are clearly laid down, and upon these the theory of salt manufacture is shown to be based.

Details of the salt manufacture are then given, followed by descriptions of the growth of "spontaneous salt," of the manufacture of salt from brine springs, of "earth salt," and lastly, of salt lakes. The final chapter is devoted to a discussion of the bearings of taxation upon the salt trade.

The book is written from the Indian view-point, and is rich in local illustrations of the manufacture; but the author has endeavoured to make, and we think has succeeded in making, the work a really good manual of general applicability.

The author is to be praised for the carefulness with which he has gathered together and arranged a large mass of facts; the result is a most useful and convenient little book of reference. M. M. P. M.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The "Phantom" Force

THE famous principles of conservation and dissipation of energy, which have done so much to promote the progress of physical science in recent years, were undoubtedly first inferred and generalised from certain similar laws in the theory of forces which, as we find noticed by Prof. Tait in NATURE (vol. xiv. p. 462), were first propounded by Newton.[1] If in any mechanical system, Newton observes, urged by any forces, to which we must add those which arise from friction, the action of a force reckoned *as a gain* in the system is measured by the product of its impulse and the space through which it is pushed back, or as a loss in the system when the product relates to a space through which the force *is allowed to act*, and if as action of the same kind in the system we also count its gains and losses of actual energy of motion, the whole amount of action in the system remains unchanged during the motion. Viewed from the standpoint of the laws of motion, force, and matter, which Newton starts with in the "Principia," and keeping in mind the special definition here given (coinciding with the modern term "potential increase") of the "action" of a force, obviously the reverse of what would vulgarly be called the action of a force *in increasing* a body's energy of motion, this proposition at first looks like a truism; but the idea of potential energy here coined by Newton[2] is really an essential one; and it besides allows the mode of action of some forces of very common occurrence in nature to be described more simply than they could be without it. The force of gravitation, of attraction and repulsion between two bodies permanently electrified or magnetised, and all dual forces or actions and reactions directed along, and depending only on the distance between two bodies, and not at all upon the time, are of this kind. The force can be completely described in these cases (and it may be looked upon in the first instance as only a measure of convenience) by the permanent gradient of energy-variation everywhere; and hence also by the permanent change of energy from one distance to another, when, as is supposed in this example, the dual force pair acts along the line of centres; since then the changes of actual energy which it produces (acting alone upon the bodies) are independent of the rotation of this line, and may be regarded either as produced with the natural motion of this line's rotation or by the same forces acting along a fixed line of centres. When two such bodies approach, or recede from each other, whatever time elapses or whatever course they may pursue about their centre of mass, not only are the momentary transfers between actual and potential energy equal in energy value at every moment of the motion (for this is *general*, and by this condition *only* the bodies returning twice to the same distance from each other might have very different energies of motion at the two returns); but the whole energy of motion which can be gained between two distances is a definite one, and as this would not be so if the bodies returned twice to the same distance with different actual energies, nor if they returned twice to the same distance with different potential energies, it follows at once that not only is the sum of the actual and potential energies at any one distance invariable with the lapse of time and with any intervening motions of the bodies, but since the gain of actual energy from this distance to any other *is the loss* of potential energy, the sum of these two energies is also the same at one distance as it is at another, and it therefore varies neither with the time nor with the distance of the bodies from each other.

In this illustrative example of two bodies (otherwise unimpelled) exerting upon each other a permanent action and reaction, several points connected with the use of the term "potential energy," as just described, require attention. In the first place, whatever the real forces are (acting in "absolute space"[3]) upon the two bodies, the Newtonian laws of motion

[1] On reading the passage again (which I here described from memory) I find that its statement is verbally but not substantially different from what I wrote above, and that in Newton's statement the signs are merely taken oppositely. Newton thus describes an "acceleration" (a gain of actual energy) as a "resistance" (*i.e.*, a force) overcome, with a corresponding loss of action in the system. This is the modern view of equivalence between potential and actual "action" or energy, but *with the signs of* these actions changed.

[2] Newton, in fact, anticipated D'Alembert's principle; and if we apply D'Alembert's principle to the motion of a single particle, the way in which it likewise coincides with the modern definition or recognition of potential energy will presently be understood, although it also reverses the signs of both of the energies concerned.

[3] The term "absolute space," or the simpler word "space," used in Newton's enunciations of the laws of motion as the field of action of "force" is nothing more than a space whose origin is either the centre of mass of all the bodies under actual observation, or any space in which that centre is moving uniformly in a straight line. If we extend our observation to new bodies found not to be moving uniformly in the original space, the old space must be given up, and a new one must be adopted (recognising the new masses), to enable us to state all the forces and to describe the motions completely, of all the bodies under observation (which is the sole problem and